Aliens: More Real Than Ever (published in the Informal Learning Review, September/October 2011 issue)

Robert L. Russell

Since H.G. Wells' novel "War of the Worlds" was published in 1898, aliens have become a staple of popular culture. Pop culture icons such as Flash Gordon, Buck Rogers, and alien creatures have populated our movie and television screens since the 1930's. In the 1990s, astronomers detected the first worlds orbiting distant stars, and as of January 2010, at least 424 of these exoplanets are known to exist. As our observation techniques improve, we look to better understand the nature of these worlds and if any have Earth-like characteristics. We are also discovering strange and seemingly "alien" forms of life on the earth, such as microbes that live thousands of feet below the surface or near deep sea vents.

In response to the public's fascination with aliens and these new research developments, science museums have developed exhibitions that focus on the search for extraterrestrial life. One of the most recent of these efforts is a an exhibition and planetarium show under development at the Maryland Science Center (MSC) that introduces students and the general public to the search for exoplanets and astrobiology.

This article summarizes recent surveys and museum audience research on these topics, recent exhibitions, and front-end audience research I have conducted for the project at MSC.

Surveys and Museum Audience Research on Extraterrestrial Life

Public opinion polls show that the public does not trust the government, that a majority believe that there is extraterrestrial life, and many believe that alien beings have visited the earth:

- A majority of adults believe the government does not, in general, share enough information; over two thirds believe the government does not tell everything it knows about extraterrestrials (ET's) and UFO's (Roper, 2002);
- Two-thirds believe there is extraterrestrial life and nearly half believe ET's have visited the earth (Roper, 2002);
- Over 10% have reported a "close encounter" with ET's (Roper, 2002);
- Most believe that intelligent life may exist on other planets, but only about one-third believe that ET's have visited the earth. (Ohio State/Scripps survey); and

 About eight percent believe they have seen a mysterious object in the sky that may have been a UFO. (Ohio State/Scripps survey).

In a front-end survey for an exhibition for the Space Science Institute, Koke (2003), perhaps the most interesting finding may be that the great majority of museum visitors surveyed reported they had never thought about the origins of the materials that make up the earth. When asked, about one-fourth reported "don't know" about the origins of these materials, about 21% reported "God" or gave "creationist" answers, and 47% reported from outside the earth (e.g., big bang, other stars, material from space, etc.). While museum visitors who are surveyed will readily supply answers, they may have no pre-conceived opinion or significant knowledge regarding the subject of the question.

Consistent with the public opinion surveys, Koke (2003) found that most (90%) museum visitors believed there is life outside of the solar system, with different types of environments and life forms. The great majority believed scientists' belief that the life we may find outside the earth will be microscopic, in part because there will be very different environments on other planets and/or different evolutionary pathways.

In brief, a majority of the general public are open to the idea that there is life outside the earth, they may not have thought very deeply or extensively about the origins of life or what forms of life may be found outside the earth.

Previous Exhibitions on Extraterrestrial Life

During the past decade, there have been several significant exhibitions that have introduced the general public to exoplanets and/or extraterrestrial life:

- New York Hall of Science "Search for Life" exhibition included exhibits on: life in extreme earth environments, water and life, looking for life on Europa and Titan, looking for planets and life outside the solar system, and "what is life?". (http://www.nysci.org/explore/exhibitions/searchForLife L2)
- Space Science Institute's "Alien Earths:" Are We Alone: 3,000 sq. ft (search for extraterrestrial life) includes exhibits on star and planet formation, Planet Quest (search for exoplanets), and the Search for Life (primarily life in extreme environments on earth). (http://www.alienearths.org/)
- American Museum of Natural History's "Exoplanets and the Search for Life" presents the science and techniques behind the study of planets orbiting nearby stars. Two historically important astronomical instruments, the Michelson Interferometer, which is on loan from the Mt. Wilson Institute and the Observatories of the Carnegie Institution of Washington; and the Johns Hopkins Adaptive Optics Coronagraph, which is now part of the Museum's permanent collection, are presented to illustrate the technical difficulties of

modern astronomical investigations. (http://www.amnh.org/exhibitions/exoplanets/)

- Pacific Science Center "Aliens: Worlds of Possibilities" includes exhibits on several themes: Life at the Edge (life in extreme environments), worlds beyond earth (exploration of other planets), the search for extraterrestrial life (SETI area), aliens in science fiction, and robotic creatures (children's conceptions of alien creatures). (http://www.pacsci.org/museumphotos/PacificSciCenter/Aliens/menu.html)
- Science Museum of London "Science of Aliens" travelling exhibition includes exhibits on several themes: Alien Fiction (science fiction portrayals of aliens), Alien Science (search for extraterrestrials), Alien Worlds (two science-based fictional planets), and Alien Communication (sending messages to extraterrestrials).

Three common themes among these exhibitions have included connecting life in extreme earth environments to the search for extraterrestrial life on other moons and planets, and what researchers look for when they are searching for extraterrestrial life, such as water. Two exhibits had sections on extraterrestrial life in science fiction and two had major themes on communication with extraterrestrial life.

Front-End Research for the Maryland Science Center

From October 2010 through January 2011, students, teachers, and adult visitors at the Maryland Science Center were surveyed from October through January 2011 to gain insight into their knowledge and interests in relation to MSC's upcoming exhibition and planetarium show on exoplanets and astrobiology. A summary of the findings for each of these groups is provided below.

Students

Students in four classrooms were asked to fill out written surveys and participate in classroom discussions concerning extraterrestrial life and exoplanets. Participating students included 50 fourth graders and 74 eighth graders. There were several key findings:

1. A majority of students believed that life can be found in extreme environments on the earth, with the "deep in the ocean," "underground," and extreme land environments (e.g., arctic/Antarctic, desert, volcanoes) as the most commonly cited places. Typical answers: "At the ocean floor where aquatic animals need to create their own light." (4th grade);"Life would be the strangest in a volcano or in water." (7th grade).

- 2. A majority believed that life can be found on other planets or moons, with Mars and Europa or other moons of Jupiter as the most commonly cited places.
- 3. Students cited environmental_conditions (e.g., water, atmosphere) most frequently as signs that there might be life on other planets, with many also citing movement and biological evidence.
- 4. Telescopes are the most commonly cited technique students believe scientists are using to find exoplanets. However, none of the students cited any of the specific techniques actually used.

Some of the experiences students would like to have in the exhibition include interactives, seeing a variety of videos or images of astronomical phenomenon, specific displays or information on aliens and life on other planets and models of space probes. Examples of a few answers:

- "See stardust, touch an actual meteor/asteroid and see pictures taken by the Hubble Space Telescope." (4th grader)
- "I would like to see if there is planets or water in the Moon, do experiments, learn more about space and watch a cool movie." (4th grader)
- "I would like to see a planetarium show that tells you about life on other planets like the one on Animal Planet." (4th grader)
- "I would want to see planets that may contain life, what they might look like to adapt to the planet's environment, how far away they are and if we can communicate with them." (7th grader)
- "Read stories about alien sightings, about what the government is doing about it. Alien technology, alien hideouts." (7th grader)

Teachers

Thirty-one teachers participating in professional development workshops at the Maryland Science Center filled out written surveys concerning their knowledge of extraterrestrial life, explanets, and what educational resources they would find most useful in the MSC project. The key findings are:

1. Nearly all teachers believed life can be found in a variety of extreme environments, with "deep in the ocean" or similar responses cited by about one-third and with other relatively extreme environments, such as the arctic/Antarctic, the desert, caves and "everywhere" cited by others.

- 2. Nearly three-fourths believed that we can find life on other worlds in our solar system, with about one-third mentioning Mars and another one-fifth mentioning other planets.
- 3. When asked what signs of life they would look for, the great majority of teachers mentioned environmental conditions, including water and air/oxygen, or evidence of living things such as fossils or other biological evidence.
- 4. When seeking exoplanets, about one-fifth of teachers mentioned a specific type of evidence scientists look for (e.g., disturbances in gravitational field, changes in light emitted from stars). Nearly half cited satellites or telescopes, without describing what specific data was being gathered.

Teachers requested standard science center experiences when asked what they would like to see or do in the new programs, including IMAX, videos or films, models, interactives including simulations, and specific experiments or interactives concerning life on other planets. Typical answers:

- "I'd like to see activities or experiments on how to detect life (such as the presence of water, oxygen, etc.) in other planets, etc."
- "Interactive games, unusual exhibits, exciting exhibits."
- "I want to see an interactive planet where I can build mountains, I can change/create the landscape and everything – including animals and living organisms."

For classroom use, teachers wanted additional informational resources such as lesson plans, websites, books, hands-on activities, and workshops for teachers and students as resources to support the exhibit and planetarium show experience.

Adults

Adults visiting the Maryland Science Center were intercepted and asked to fill out brief written surveys. Key findings for the 102 visitors surveyed are presented below:

- 1. Nearly all adults believed that life can be found in a variety of extreme environments on earth, with about one-third citing subzero/arctic type environments, one-third the bottom of the ocean, one fourth desert, and others a variety of other environments (e.g., volcanos) as extreme environments. When interviewed, a large proportion of visitors reported hearing about life in extreme ocean environments such as deep sea vents.
- 2. A majority of adults had heard of research about research about exoplanets,

but in general, they seemed unfamiliar with details. Technology (e.g., telescopes) or techniques (e.g., light refraction) were most often mentioned as techniques that scientists use to find exoplanets.

- 3. The great majority of adults believed that we may find life on other planets, with about half citing Mars as the most likely location for life and a significant proportion citing other moons (e.g., Europa) as likely locations.
- 4. A majority of adults were able to identify at least one factor they would look for if searching for signs of life on other planets, most commonly citing environmental conditions About one-third said "water," about one-third "oxygen," and about one-fourth said "temperature."

Adults expressed interest in knowing more about: current science research concerning other planets, life on other planets, what we really know, and the scientists conducting the research. They were interested in a wide range of experiences, including interactives, IMAX films, displays of environments of other planets, and informational displays. Typical answers:

- "Comprehensive what can we say we know, what is the evidence?"
- "Proof, how they find out, what are the extremes."
- "What is the current research, what have we found out, we can we expect form the future."
- "Proximity to earth, what kind of suns (like ours?), what size and gravity these planets have."
- "How do we come to conclusions, research processes, what life sounds like, looks like, other types of life forms."
- "Confirmation of other life and how does it live."

Summary of Findings for Maryland Science Center Front-End Research

The students, teachers and adults surveyed for MSC showed more similarities than differences regarding their knowledge of exoplanets and extraterrestrial life. While students' responses are less sophisticated than teachers' and adults', the general findings for all three groups were similar.

- 1. Those surveyed rarely mentioned "aliens" as they are presented in science fiction (i.e., "little green men," etc.). Thus, it may not be important to have any exhibits on sci-fi "aliens."
- 2. Because the great majority of those surveyed were able to cite a variety of

extreme environments, they seem to implicitly accept that this life is very different than the life we are familiar with. Thus, their minds seem open to other types of life that may be found on other planets and moons.

- 3. Research and reports about exoplanets have only emerged in the past few years. Most surveyed believed there are exoplanets, but there were few explanations of the actual research basis for identifying these planets. Adults who were interviewed expressed interest in knowing more about this research, what we currently know, and what the research questions are.
- 4. While the majority of those surveyed cited water and oxygen or the atmosphere as signs they would search for in identifying planets with life, they also seemed open to life in other types of environments.

Conclusions

New research findings have spurred interest in extraterrestrial life and exoplanets. Students and adults surveyed for the Maryland Science Center were familiar with life in extreme environments on earth and open to the possibility of life on other planets. Adults in particular were interested in finding out more about how scientists research extraterrestrial life and what we really know at present.

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Robert L. Russell is Senior Education Associate at the National Center for Interactive Learning/Space Science Institute and Principal, Informal Learning Solutions, an informal education consulting business. He can be reached at: eldrbob@gmail.com